US007601010B1

(12) **United States Patent**
Wu

(10) **Patent No.: US 7,601,010 B1**
(45) **Date of Patent: Oct. 13, 2009**

(54) **PLUG CONNECTOR WITH IMPROVED CABLE ARRANGEMENT AND HAVING RETAINING ARRANGEMENT SECURELY RETAINING MATING SUBSTRATE THEREIN**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/321,080**

(22) Filed: **Jan. 12, 2009**

(51) **Int. Cl.**
H01R 12/00 (2006.01)

(52) **U.S. Cl.** **439/76.1**; 439/606; 439/466; 439/468; 439/694; 439/902

(58) **Field of Classification Search** 439/76.1, 439/660, 606, 466, 468, 694, 881, 902
See application file for complete search history.

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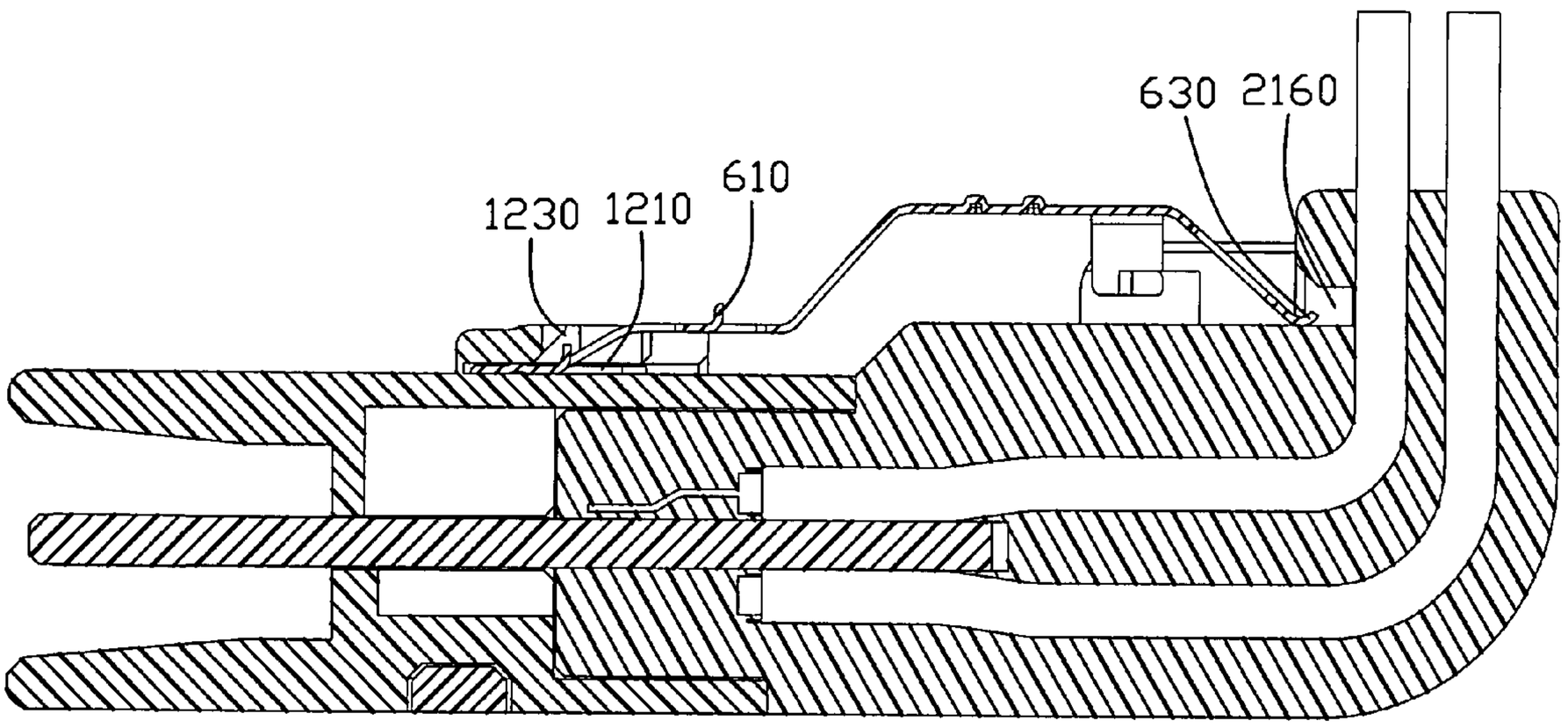
(57) **ABSTRACT**

A plug connector, mated with a complementary connector, includes a housing, a printed circuit board received in the housing, a cable with a plurality of conductors electrically attached to corresponding electrical pads of the printed circuit board, and a fastening portion. The housing includes a front housing defining a mating interface and L-shape rear housing. The mating interface includes a pair of tongue sections and an opening defined between the tongue sections. The printed circuit board has a plurality of electrical pads formed thereon, and defines a mating portion accessible from the mating interface and parallel to the pair of tongue sections. The fastening portion includes a connecting portion received in the housing and at least one column post passing through the housing and the printed circuit board.

10 Claims, 7 Drawing Sheets



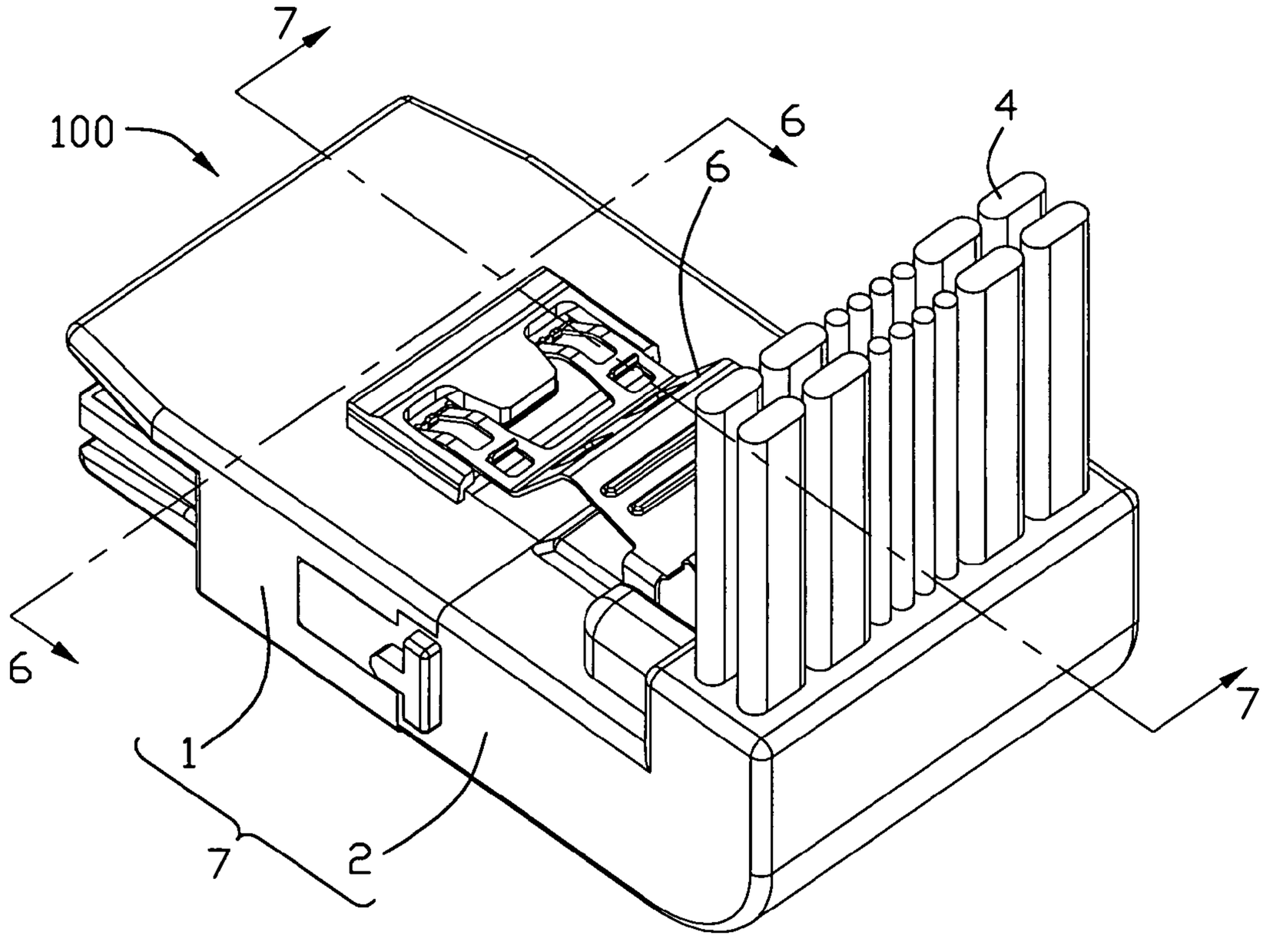


FIG. 1

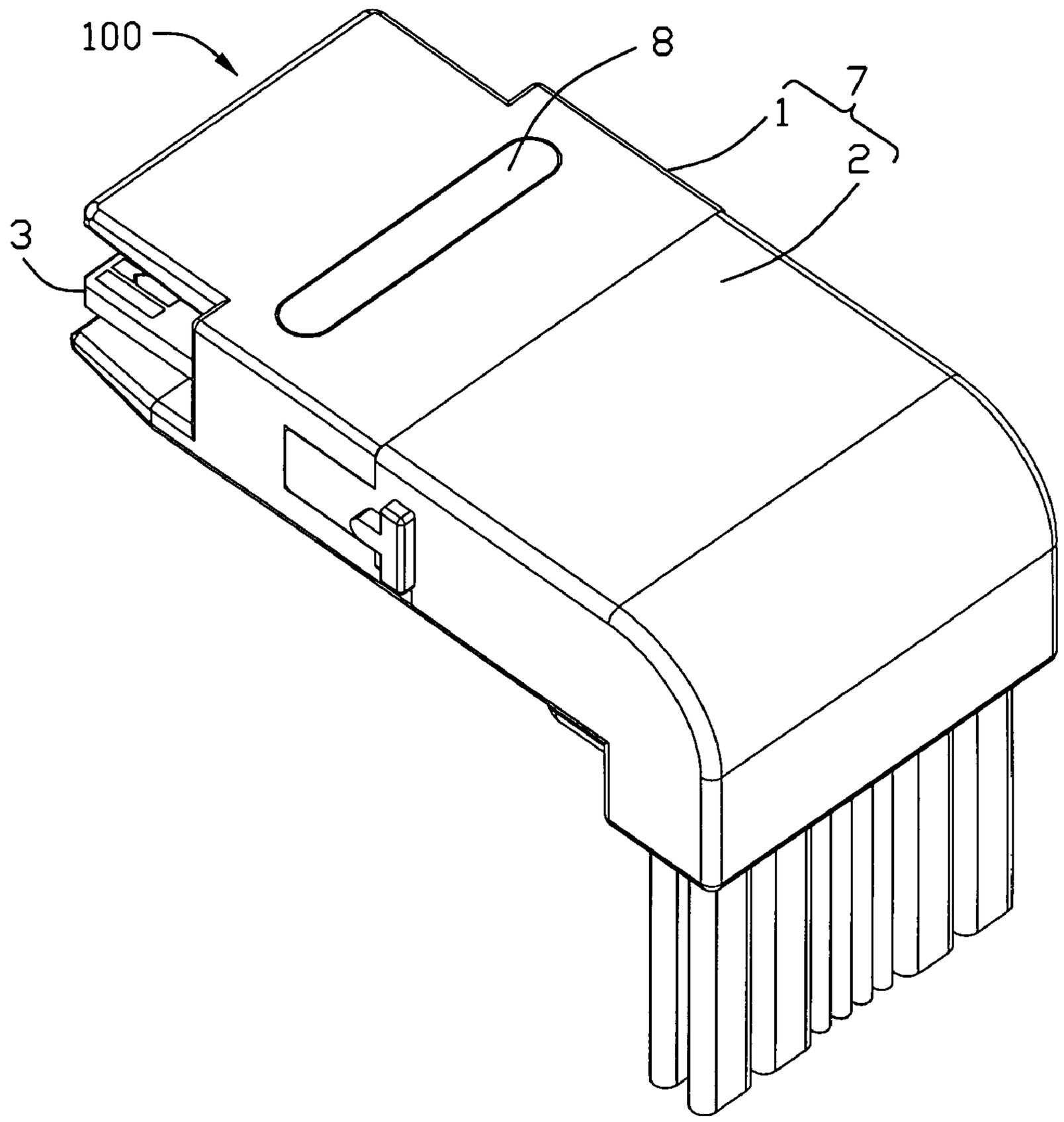


FIG. 2

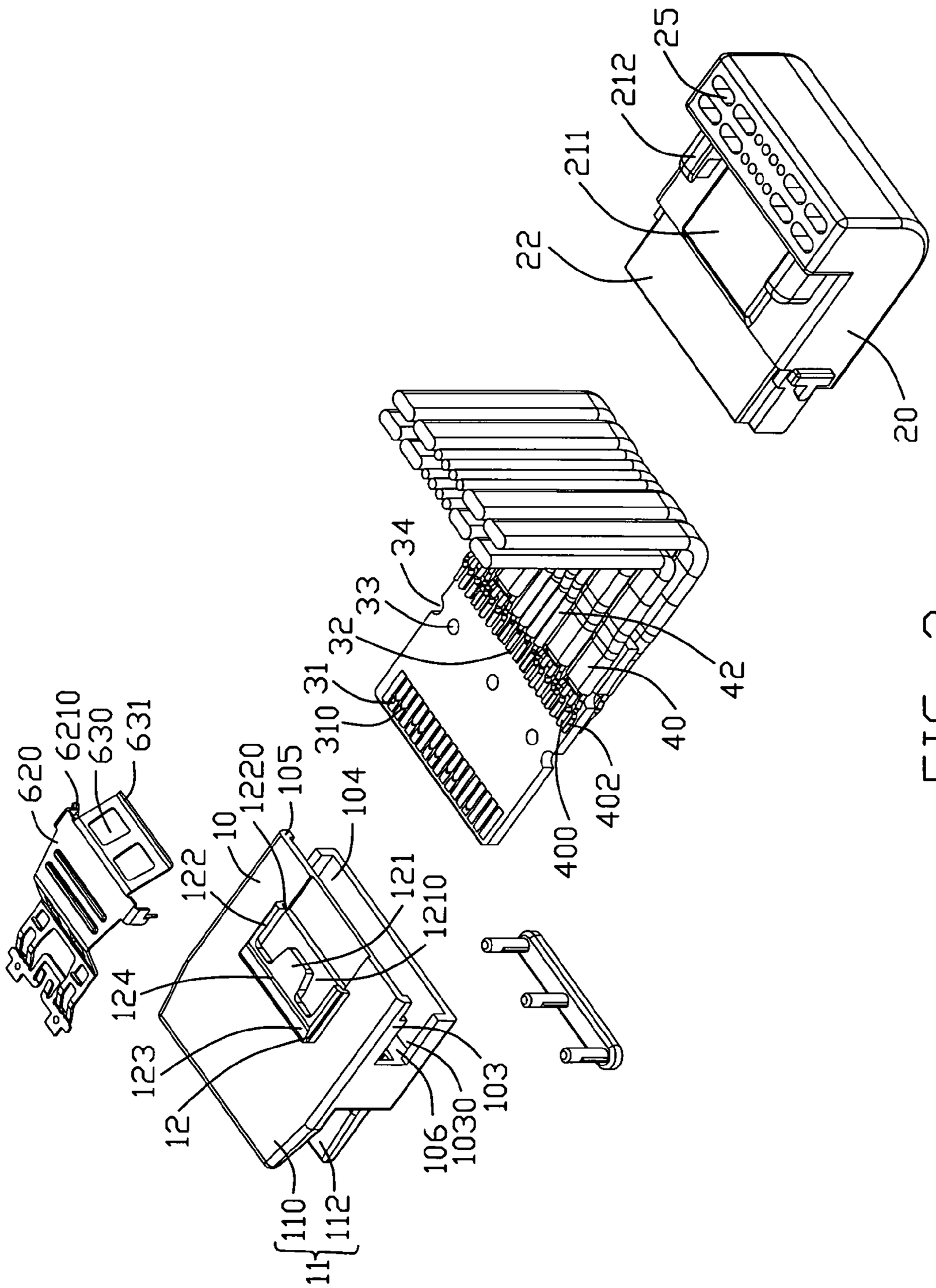

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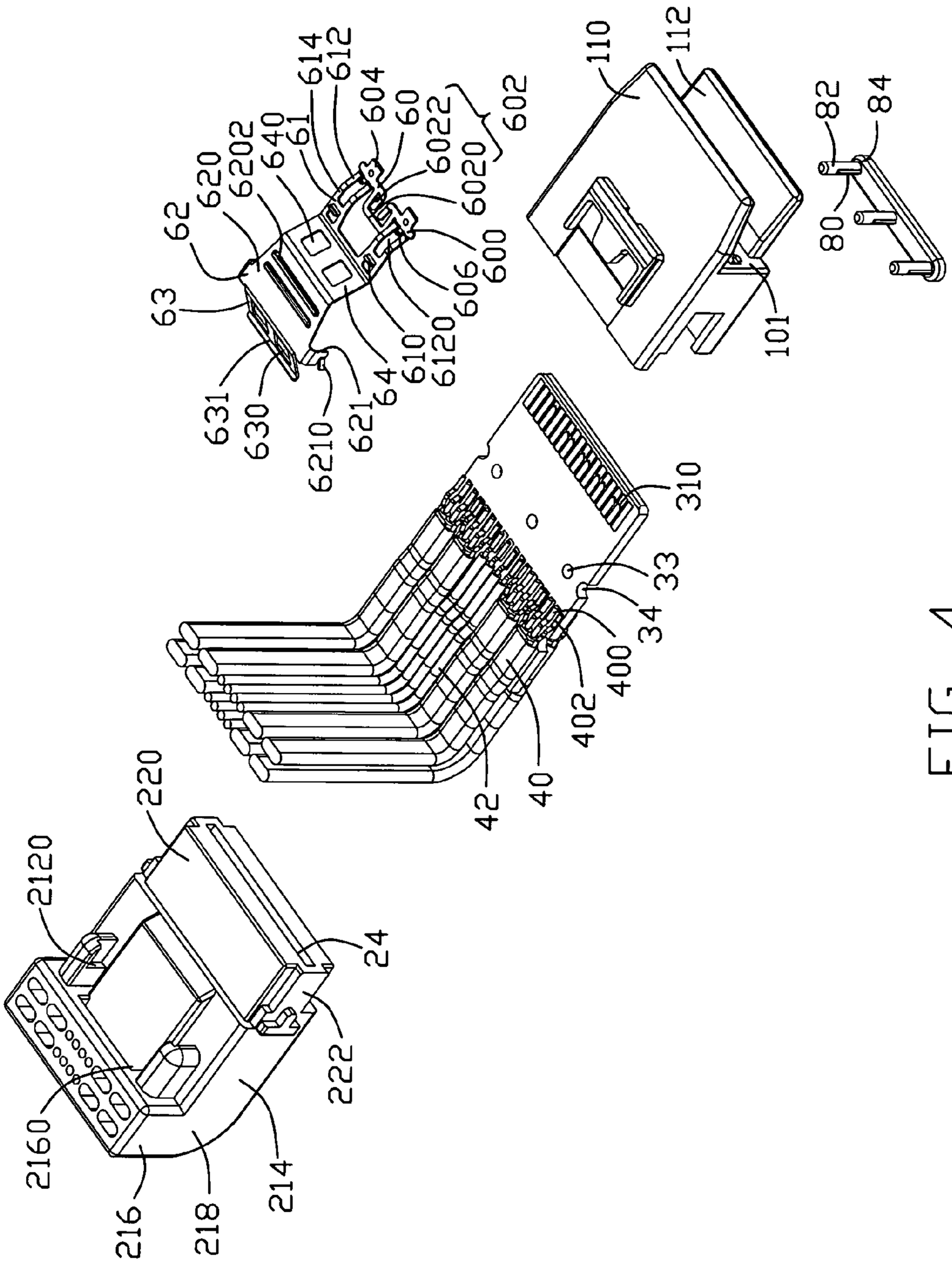
FIG. 3


110
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6210
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2160

FIG. 4

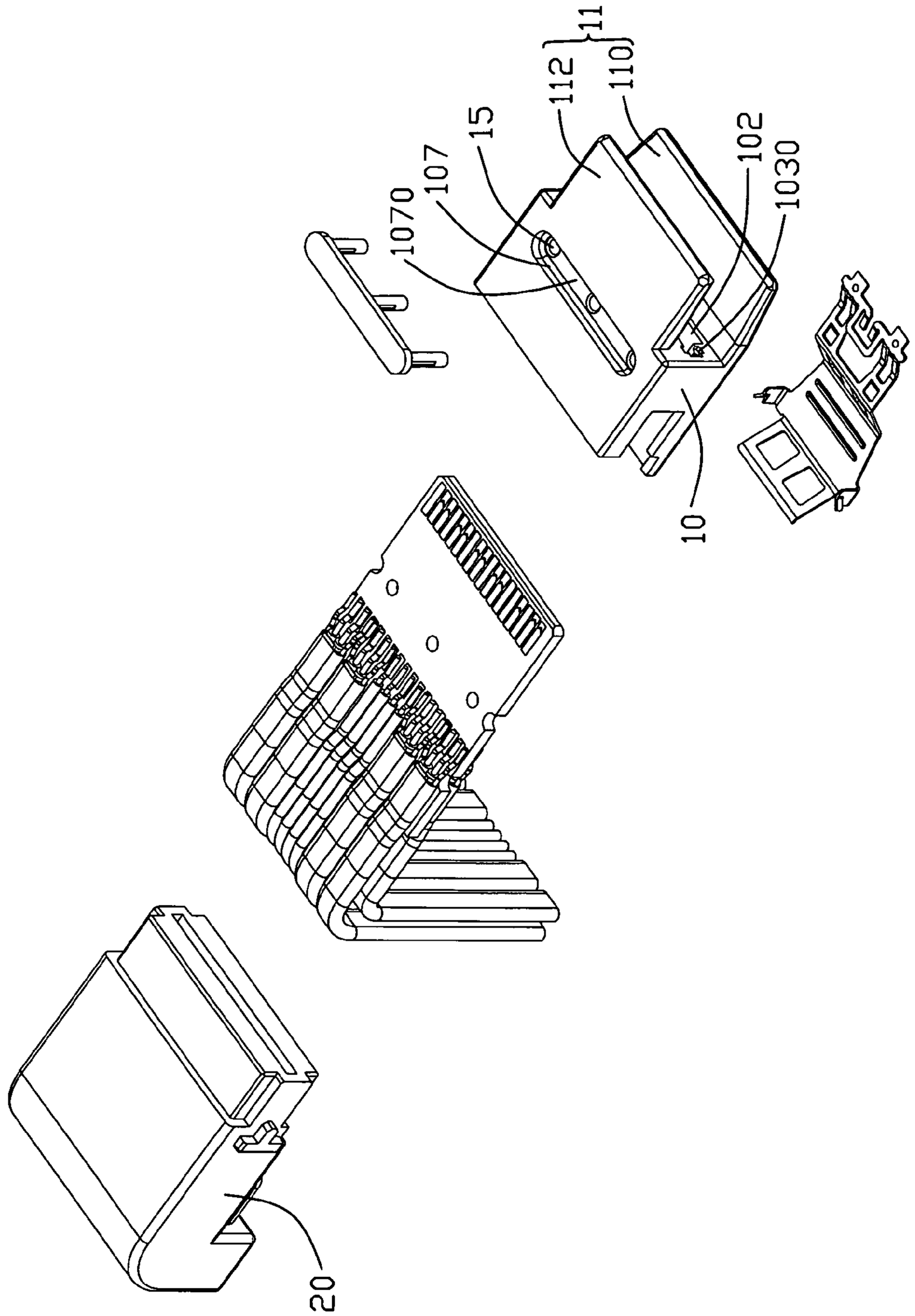

FIG. 5

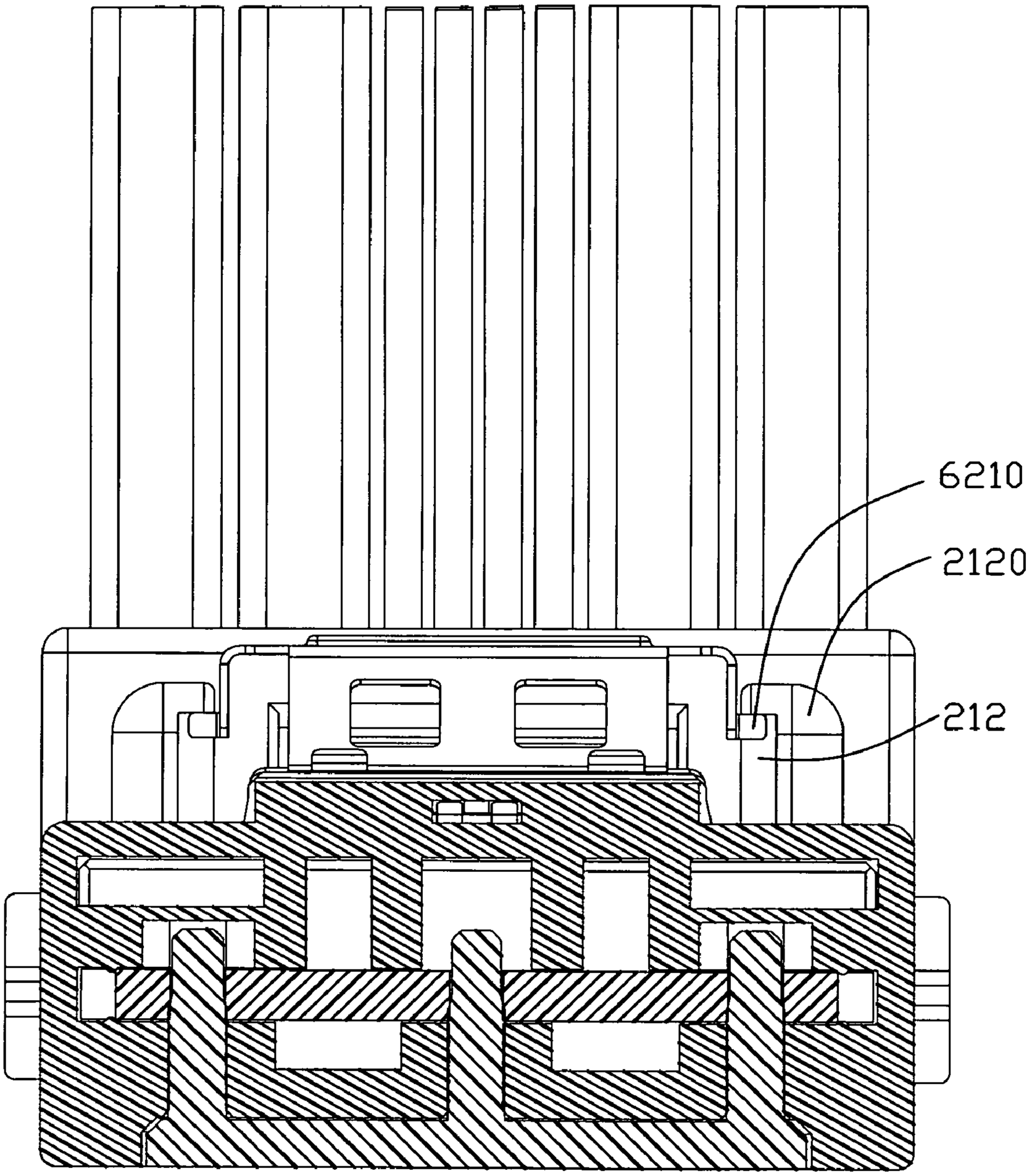

FIG. 6

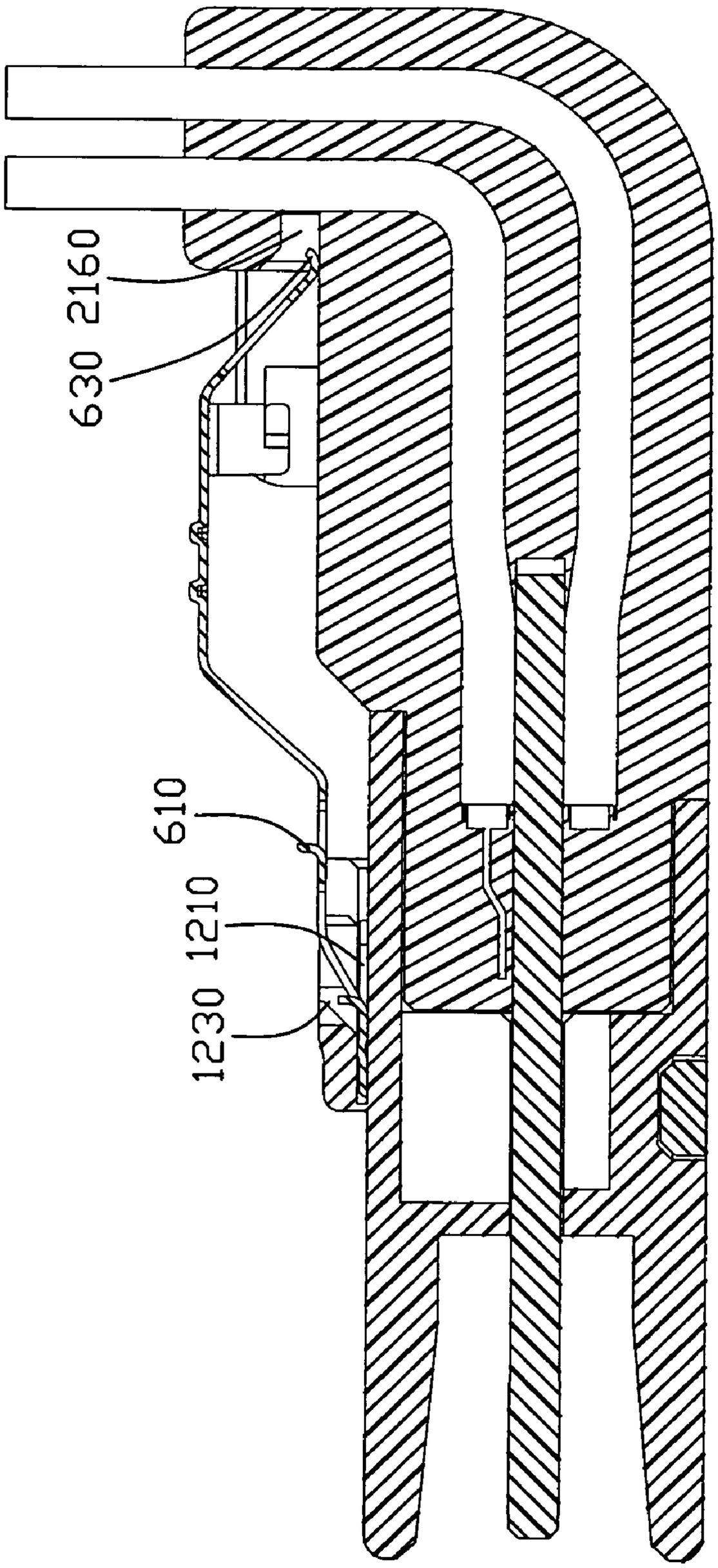

FIG. 7

PLUG CONNECTOR WITH IMPROVED CABLE ARRANGEMENT AND HAVING RETAINING ARRANGEMENT SECURELY RETAINING MATING SUBSTRATE THEREIN

This application is related to a copending U.S. patent application Ser. invented by Xu, Bin and Liu, Su-feng assigned to the same assignee as this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a plug connector, and more particularly to a plug connector with circuit board connector mating substrate securely retained therein by means of a retaining pins extending therethrough.

2. Description of the Prior Art

Present electrical devices include so many internal components as to define complex internal spaces. Thus, internal connectors are needed to be adapting to the internal space.

U.S. Pat. No. 7,410,365, issued to Wu on Aug. 12, 2008, discloses a plug connector with improved engaging means that are assembled to the housing for locking board printed circuit board toward the housing reliable. However, the conventional housing extends along a horizontal direction is not adapt to some electrical devices.

Hence, in this art, a plug connector to overcome the above-mentioned disadvantages of the prior art should be provided.

BRIEF SUMMARY OF THE INVENTION

A primary object, therefore, of the present invention is to provide a plug connector with small structure.

In order to implement the above object, the plug connector, mated with a complementary connector, comprises a housing, a printed circuit board received in the housing, a cable with a plurality of conductors electrically attached to corresponding electrical pads of the printed circuit board, and a fastening portion. The housing comprises a front housing defining a mating interface and L-shape rear housing. The mating interface comprises a pair of tongue sections and an opening defined between the tongue sections. The printed circuit board has a plurality of electrical pads formed thereon, and defines a mating portion accessible from the mating interface and parallel to the pair of tongue sections. The fastening portion comprises a connecting portion received in the housing and at least one column post passing through the housing and the printed circuit board.

Other objects, advantages and novel features of the invention will become more apparent from the following detailed description of a preferred embodiment when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a plug connector in according with the present invention;

FIG. **2** is a view similar to FIG. **1**, but taken from a different aspect;

FIG. **3** is an exploded, perspective view of the plug connector in according with the present invention;

FIGS. **4-5** are views similar to FIG. **3**, but taken from different aspects;

FIGS. **6-7** are cross-section views of the plug connector taken along lines **7-7** to **8-8** of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to a preferred embodiment of the present invention.

FIGS. **1** to **4** illustrate perspective views of an electrical plug connector **100** made in accordance with the present invention and used to exchange electrical signals and be connected to the complementary connector (not shown). The plug connector **1** comprises a housing member **7** having receiving space therein and configured by a front piece and a rear piece, a printed circuit board **3** securely assembled in the receiving space of the housing member **7**, a plurality of cables **4** electrically terminated with the printed circuit board **3**, a latch **6** assembled on the housing member **7** for inter locking with the complementary connector, and a fastening portion **8**.

Referring to FIGS. **5** to **7**, the front housing piece **1**, which is made of insulative material with robust rigidity or other material, such as metal, comprises a rectangular body portion **10** defining a central receiving slot (not labeled) therethrough, and a tongue portion **11** having first and second tongue sections **110**, **112**. The first and second tongue sections **110**, **112** respectively extends forwardly from a front surface **101** of the body portion **10** and an opening (not labeled) formed between the first and second tongue sections **110**, **112**. The first and second tongue sections **110**, **112** together with the opening form a mating interface (not labeled) of the front housing piece **1**.

The body portion **10** defines a rectangular receiving space **104** recessed forwardly from a rear surface thereof to communicate with the receiving slot **102**, and thus, forming a pair of longitudinal walls **105**, a pair of lateral walls **103**, and an inner face **106**. Each lateral wall **103** defines a cutout **1030** to communicate with the outmost lateral surface of the lateral wall **103** and the receiving space **104**. The receiving slot **102** recesses forwardly from the inner face to the front surface **101** of the body portion **10** and forms a pair of upper a lower surfaces opposite to each other and perpendicular to the inner face **106**. Each lateral wall **103** has a cutout **1030** to form an upper lateral arm and lower lateral arm (not labeled). The outmost surface of the cutouts **1030** communicates with the corresponding lateral walls **103**. A groove **107** recesses upwardly from the bottom surface of the body portion **10** to form a receiving space (not labeled) and a blocking surface **1070**. Triple circular depressions holes **15** extend upwardly from the blocking surface **1070** to communicate with the receiving slot **102**.

The body portion **10** forms an M-shape engaging portion **12** on a top surface and adjacent to the rear surface thereof. The engaging portion **12** comprises a protruding section **121** and a pair of arms **122** located at opposite sides of the protruding section **121**, all extending rearward from a transverse main section **123**. A slit **1210** (FIG. **3**) is formed between the protruding section **121** and a top surface of the body portion **12** to extend into the main section **123** of the engaging portion **12**. The top surface of the engaging portion **12** is higher than the top surface of the main section **123**, and an inclined surface **124** is connected to the two top surfaces of the engaging portion **12** and the main section **123**. A pair of trough **1220** is respectively formed in the arms **122** and open toward each other.

The rear housing piece **2** of the present invention is made of PVC material and in the form of L-shape configuration. In other alternative embodiments, the rear housing piece **2** can or also be made from other material, same as that of the front housing piece **1** or different from that of the front housing piece **1**. The rear housing piece **2** comprises a main portion **20** and a guiding portion **22**. The main portion **20** comprises a

horizontal and rectangular first portion **214**, a vertical and rectangular second portion **216**, and a bending portion **218** connecting the first portion **214** to the second portion **216**. A transverse slot **2160** is formed on the front surface of the second portion **216** in communication with the upper surface of the main portion **20**. A flat extruding section **211** protrudes upwardly from the upper surface of the first portion to extend across the first portion **214** along front-to-rear direction. The flat extruding section **211** extends into the slot **2160** and a receiving space is defined between the upper surface of the slot and the flat extruding section **211**. A pair of ear sections **212** are located at opposite sides of the extruding section **211** and connected to the second portion **216**. Each one of the ear sections **212** has a recess **2120** backwardly recessed from the front surface thereof. The two recesses **2120** face to each other. The guiding portion **22** comprises a rectangular main body **220** and a pair of guiding projections **222** on opposite sides of the main body **220**. The two guiding projections **222** are respectively across the two side surfaces of the main body **220** along front-to-rear direction. The outmost surface of each guiding projection **222** is coplanar with the main portion **20**. A through slot **24** extends through the guiding portion **22** and into the main portion **20** to receive the part of the printed circuit board **3** and a part of the cables. The front part of the through slot **24** is between the two guiding projections **222** and has a width equal to the body portion **220**.

The printed circuit board **3** has a plurality of first conductive traces **31** disposed along its leading edge which are intended to mate with the contacts (not shown) of the complementary connector when the plug connector **100** is inserted into the complementary connector, a plurality of second conductive traces **32** at middle thereof to be respectively connected to the cables **4**, and triple holes **33** located between the first and second traces **31**, **32** and arranged in a line. Each side edge of the printed circuit board **3** defines a pair of semi-circular positioning holes **34** arranged along the front-back direction. In order to facilitate the so called hot-plug function, each of the first conductive traces **31** which are used for signal transmission are formed with a V-shape cutout **310** to let the first conductive traces **31** which are interconnected with ground contacts of the complementary connector firstly and disengaged from the complementary connector later. Such V-shape cut-outs **310** assure the signal transmission without being interrupted. Of course, the V-shape cutouts **310** also can be omitted here or have other configuration.

The cables **4** comprises two sets of sub-assemblies in a stacked relationship. Each set comprises four serial Attached Technology Attachment (ATA) standard cables **40** for high speed signal transmission and four strand wires **42** for low speed signal transmission. Of course, the strand wires **42** may not be included into the cable set in this embodiment or other embodiments according to different requirements. Each serial ATA standard cable **40** comprises a pair of signal conductors **400** respectively transmitting positive signal and negative signal, and a pair of grounding conductors **402** arranged at opposite outer sides of the pair of signal conductors **400** for providing grounding to the signal transmission.

The latch **6** is stamped and formed from a metallic sheet and comprises a retaining portion **60**, a pair of locking portions **61** extending upwardly and backwardly from the retaining portion **60**, a generally horizontal pressing portion **62** and an inclined supporting portion **63** slantwise extending from the pressing portion **62**. The latch **6** further forms an inclined intermediate portion **64** connecting the pressing portion **62** with the locking portions **61**.

The retaining portion **60** has a pair of transverse bar sections **600** respectively connecting with front edges of the locking portions **61**, an engaging section **602** connecting with opposite inner ends of the pair of bar sections **600** and extending backwardly from the bar sections **600**, and a pair of positioning sections **604** respectively extending forwardly from front edges of the pair of bar sections **600**. Outmost end of each bar section **600** extends beyond outmost edge of corresponding locking portion **61** and served as guiding means for the latch **6**. The engaging section **602** is located between the pair of locking portion **61** and comprises a rectangular frame **6020** located in a horizontal surface and a pair of elastic snapping section **6022** extending into the space circumscribed by the frame **6020** with distal ends bending upwardly. Each locking portion **61** comprises an inclined first section **612** extending rearward and upwardly from the retaining portion **60** and a flat second section **614** extending rearward from the first section **612** to connect with the intermediate portion **64**. Each inclined first section defines a cutout **6120** therein for increasing flexibility thereof. Each cutout **6120** extends form the first section **612** to the second section **614**. The second section **614** is formed with a pair of latch sections **610** extending upwardly and rearward form a front portion thereof. A pair of stop sections **606** are respectively formed with the bar sections **600** and extending into the cutout **6120** and curve upwardly. The pressing portion **62** comprises a body section **620** and a pair of side beams **621** extending downwardly from opposite lateral ends of the body section **620**. Each side beam **621** is formed with a spring tab **6210** extending outwardly therefrom. The body section **620** is formed with a plurality of rims **6202** for easy handling. The supporting portion **63** defines a pair of rectangular openings **630** and forms a curved edge **631** at a free end thereof. The intermediate portion **64** defines a pair of elongated cutouts **640**.

In assembly of the plug connector **100**, the two sets of cables **4** are respectively soldered to the second conductive pads **32** located on the upper and lower surfaces of the printed circuit board **3**, and then are bend at a proper position. The rear housing piece **2** is then molded over the printed circuit board **3** and the cables **4** to form a plurality of different-size receiving passages **25**. The rear portion of the printed circuit board **3** is received in the through slot **24** formed in the guiding portion **22**, and the cables **4** respectively protruding through the corresponding receiving passages **25** to expose out of a rear surface of the rear housing piece **2**. The pair of positioning holes **34** located at a relatively rear position are filled with material of the rear housing piece **2** to increasing the retaining force between the rear housing piece **2** and the printed circuit board **3**. Of course, the rear housing piece **2** can be molded firstly, and then is pushed forwardly toward the cables **4** and the printed circuit board **3** to enclose the junctions between the cables **4** and the printed circuit board **3**.

The rear housing piece **2** with the cables **4** and the printed circuit board **3** is assembled to the front housing piece **1** along the back-front direction. With the guidance of the pair of guiding projections **222** of the guiding section **22** sliding into the cutouts **1030** of the lateral walls **103**, the front portion of the printed circuit board **3** protrudes through the receiving slot **102** to be exposed between the first and second tongue sections **110**, **112** until a front surface of the rear housing piece **2** abuts against the front inner face **106** of the front housing piece **1**. Thus, the through holes **33** of the printed circuit board **3** respectively align with the arc sections of the positioning cavities **14** and the circular depression **15**. To enhance the combination of the printed circuit board **3** and the front housing piece **1**, the fastening portion **8** are employed. The fastening portion **8** comprises a connecting board **84** and three column posts **82** respectively attached on the connecting

board **84**. Each column post **82** has a rim **80** on one side thereof. The three column posts **82** respectively extend through the circular depressions **15** and the three holes **33** into receiving space of the front housing **11** with the rims **80** respectively compressing on the inner surface of the circular depressions **15**, and the connecting board **84** received in the circular depression **15**. Via the fastening portion **8**, the printed circuit board **3** is reliably retained to the front housing piece **1** and has no possibility of being pulled out from the front housing piece **1** when user is pulling the cables **4**, further enhancing the engagement between the front and rear housing pieces **1**, **2**. The fastening portion **8** and the three through holes **33** serve as engaging means to position the printed circuit board **3** to the front housing piece **1**. Noticeably, the printed circuit board is wholly received in the housing member **7**, and integrally molded with the rear housing piece **2**. Similarly, the front ends of the cables **4** are integrally molded with the rear housing piece **2** for achieving a reliable connection therebetween.

Particularly referring to FIGS. **1** to **3** in conjunction with FIGS. **4-7**, the latch **6** is assembled to the front and rear housing pieces **1**, **2**. A forward pressing force is exerted on the latch **6**. The spring tabs **6210** of the pressing portion **62** respectively slide along the recesses **2120** of the ear sections **212** of the rear housing piece **2**. At the same time, with the guidance of the outmost ends of the retaining portion **60** sliding along the grooves **1220** of the arms **122** of the front housing piece **1**, the bar section **600** and the engaging section **602** are received in the slit **1210** with the positioning sections **604** and the snapping sections **6022** respectively locked into the slots **1230** to prevent the latch **6** from moving rearward when the plug connector **100** mates with the complementary connector. The pair of stop sections **606** is located in front of the main section **123** for preventing excessive forward movement of the latch **6**. The supporting portion **63** is located above the extruding section **211** of the rear housing piece **2** with the curved edge **631** abutting against a surface of the extruding section **211** and extending into the transverse slot **2160** of the second portion **216**. The spring tabs **6210** of the pressing portion **62** elastically engage with inner surfaces of the recesses **2120** of the ear sections **212** for preventing the latch **16** from escaping the recesses **2120** of the rear housing piece **2**. The pressing portion **62** is downwardly movable relative to the rear portion of the rear housing piece **2** to deflect the locking portion **61** toward the front and rear housing pieces **1**, **2**.

The complementary connector has corresponding structure locking with the pair of latch sections **610** of the latch **6** to realize the reliable engagement with the plug connector **100**. When the plug connector **100** is to be disconnected from the complementary connector, a downward pressing force is exerted on the pressing portion **62** of the latch **16**. The pressing portion **62** moves downwardly and the locking portion **61** creates a vertical displacement toward the front housing piece **1**. The retaining portion **60** is engaged with the front housing piece **1** and the supporting portion **63** extends into the transverse slot **2160** to press on the rear housing piece **2**, thus, together form a girder. The vertical displacement of the locking portion **61**, particularly the latch sections **610**, is big spatially enough to realize the disconnection between the plug connector **100** and the complementary connector easily.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A plug connector for mating with a complementary connector, comprising:

a housing comprising a front housing defining a mating interface and a L-shape rear housing, said mating interface comprising a pair of tongue sections and an opening defined between the tongue sections;

a printed circuit board received in the housing and having a plurality of electrical pads formed thereon, the printed circuit board defining a mating portion accessible from the mating interface and parallel to the pair of tongue sections;

a cable with a plurality of conductors electrically attached to corresponding electrical pads of the printed circuit board;

a fastening element securely anchored to the housing and having at least one column post extending through the printed circuit board; and

a latch stamped and formed from a metallic plate, said latch comprising a retaining portion, a pair of locking portions extending upwardly and backwardly from the retaining portion, a generally horizontal pressing portion and an inclined supporting portion slantwise extending from the pressing portion;

wherein the rear housing piece comprises a horizontal and rectangular first portion, a vertical and rectangular second portion, and a bending portion connecting the first portion to the second portion;

wherein the second portion comprises a transverse slot on the front surface thereof to communicate with the upper surface of the first portion of the rear housing piece;

wherein the inclined supporting portion has a curved edge at a free end thereof, and said curved edge extending into the transverse slot of the rear housing.

2. The plug connector as claimed in claim **1**, wherein the printed circuit board is wholly received in the housing and only accessible from the mating interface of the housing.

3. The plug connector as claimed in claim **1**, wherein the rear housing piece is molded over the printed circuit board together with the cables.

4. The plug connector as claimed in claim **1**, wherein the rear housing piece is attached to the front housing piece for together receiving the printed circuit board therein.

5. The plug connector as claimed in claim **1**, wherein the fastening element comprises a connecting portion received in the housing and said column post extending through the printed circuit board and the housing.

6. The plug connector as claimed in claim **5**, wherein the front housing piece comprises a groove recesses upwardly from the bottom surface thereof to form a receiving space and a blocking surface.

7. The plug connector as claimed in claim **6**, wherein the front housing piece defines at least one circular depression extending upwardly from the blocking surface.

8. The plug connector as claimed in claim 7, wherein the printed circuit board comprises a plurality of first conductive traces disposed along its leading edge which are intended to mate with the contacts of the complementary connector, a plurality of second conductive traces at middle thereof, and at least one hole located between the first and second traces.

9. The plug connector as claimed in claim 8, wherein the connecting portion of the fastening portion is received in the receiving space of the front housing and the column post pass through the circular depression of the rear housing and the holes of the printed circuit board.

10. The plug connector as claimed in claim 8, wherein the column post comprises a rim compressing on the inner surface of the circular depression.

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